MARQUETTE BUSINESS REVIEW

A JOURNAL OF FUNDAMENTAL BUSINESS PRINCIPLES

DECEMBER, 1957

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Volume I Number 3

Published by Bureau of Business and Economic Research
Robert A. Johnston College of Business Administration
Marquette University Milwaukee 3, Wisconsin

MARQUETTE BUSINESS REVIEW

A Journal of Fundamental Business Principles

Published February, April, June, October and December by the Bureau of Business and Economic Research, Robert A. Johnston College of Business Administration, Marquette University, Milwaukee 3, Wisconsin.

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MANAGERIAL DECISION-MAKING - - A CHALLENGE

by

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The business enterprise is one of the most important socio-economic units in the United States. Some 50 million persons expect fair wages plus personal satisfactions and advantages from their jobs with roughly 4 million businesses; investors rely on these enterprises for the protection and conservation of their capital, as well as a return on their investment; and society expects these enterprises to provide the goods and services required by the needs and desires of its members.

Because management is of fundamental importance in assuring that businesses fulfill these obligations, it is obvious that what managers do when they manage is vital to both the individual firm and the national economy. Whatever else management writers and practitioners say that managers do, there is general agreement that primarily they make decisions. This decision-making has been called the "heart of administration";[1] it is the key to business operations and to the job of the administrator.[2]

In spite of its extraordinary significance, the subject of decision-making has, until recently, received very little attention. Executives themselves are remarkably candid about their own ability to analyze the act of decision — usually they admit that they just don't know how they do it. The old-style "rule of thumb," the intuitive "pure hunch" are not enough in today's scientific management as fathered by Frederick W. Taylor early in the 20th Century. But latter-day executives must make as many decisions as did their predecessors and they must arrive at these decisions through some definable process. Experts in many areas of human activity have attempted to interpret the process in terms of their own specialties — mathematics, economics, psychology, neurology, communications and many others. The researcher soon discovers, however, that it is difficult to mass these diverse contributions into a single frame of reference, often because his inquiries are unavoidably colored by his own personal preconceptions. A definition of terms must precede any evaluation of such contributions and of any conclusions to be drawn from them. "Decision," "judgment" and "decision-making" are the terms with

1. Herbert Alexander Simon. *Administrative Behavior* (New York: The Macmillan Co., 1947), p. xiv.

2. Robert W. Crawford. "Operations Research and Its Role in Business Decisions," *Planning for Efficient Production,* Manufacturing Series No. 206 (New York: American Management Association, 1953), p. 4.

which this study is concerned and which will be examined in some detail.

Decision: Etymologically, "to decide" means "to cut off" and in present usage suggests coming to a conclusion. Basically, it "presupposes previous consideration of a matter causing doubt, wavering, debate or controversy and implies the arriving at a more or less logical conclusion that brings doubt, debate, etc. to an end."[3]

Many writers have taken great pains to distinguish "decision" from "habit." They may approach the problem from different viewpoints — that of the management scholar or practitioner, the psychologist, the economist; Chester I. Barnard, president of the Rockefeller Foundation and formerly president of the New Jersey Bell Telephone, seems to sum up their findings most succinctly:

> The acts of individuals may be distinguished in principle as those which are the result of deliberation, calculation, thought and those which are unconscious, automatic, responsive, the results of internal or external conditions present or past. In general, whatever processes precede the first class of acts culminate in what may be termed "decision."[4]

The second class may well be called "habit." Most writers emphasize this distinction between the conscious and the unconscious action, the volitional or involuntary; although a few maintain that if the individual follows one course of action, there are other courses of action that he foregoes and thereby makes a "decision" even though it be merely an established reflex action as takes place when a typist strikes a particular key on the typewriter.

The keynote idea common to all these writers is the selection of one alternative from two or more alternatives. This leads to a number of implications:

1. If a decision is a selection of one from among several alternatives, then there must be a reason for anyone's making a selection. As everyone knows from personal experience, careful reflection on the appropriateness of alternatives is a burdensome task which requires considerable mental effort and which should not be done carelessly. It does not seem rational to reflect on the suitability of alternatives without knowing exactly why. Thus, we may say that decision-making should be purposive behavior.

2. Since decision-making ought to be purposive behavior, the selection of one from among several alternatives may consist in a decision to seek a particular end, goal or

3. Noah Webster. *Dictionary of Synonyms* (Springfield: G. & C. Merriam Co., 1942), p. 224.

4. Chester I. Barnard. *The Functions of the Executive* (Cambridge: Harvard University Press, 1938), p. 185.

objective or in the selection among means to achieve some end.[5]

3. The selection or choice of one from among several alternatives implies a process of evaluation which culminates in a judgment. That is, reasons for and against one alternative and others have to be sought for and appraised. Ultimately, a final judgment must be made.

If these conclusions are accepted, the term "decision" must be taken to mean a judgment among ends or among means to achieve some end. But "judgment" is an ambiguous term; if it is to have value as an essential part of the definition of decision, the term "judgment" must in its turn be defined.

Judgment: Originally was the action of a judge or magistrate who pronounced the right or law in a contested question — "jus dicere," to declare the law.[6] It has come to mean any action of the mind which, after certain deliberation, pronounces the difference or agreement of two elements of thought. In the words of the psychologist Professor Francis Lelande Harmon:

> Judgment is concerned with the conscious formulation of relationships among sense objects, images or ideas. It implies apprehension of the things to be compared, as well as certain relational concepts of size, weight, goodness and beauty. Mere perception of objects does not necessarily lead to expression of judgments regarding their interrelationships, nor does a sensorimotor reaction to some specific material relationship, for example a difference in size, shape or brightness, necessarily imply an intellectual judgment. . . . Furthermore, the understanding of a judicial statement does not constitute a judgment in itself. . . . Judgment, in a word, involves assent on the subject's part — an intellectual reaction which, under some circumstances, may be either given or withheld. . . . Psychologically, an erroneous judgment is as

5. A small percentage of the decisions of an individual relates to his structure of values — these decisions determine his ultimate ends. Such value decisions are based upon the varying backgrounds and accumulated experiences of the individuals concerned. Since each person carries around a different conceptual structure in his mind, decisions among ends are subjective decisions, that is, such decisions are measured by one's personal standards rather than by objective standards. All other decisions are directly or indirectly related to means. In terms of a means-ends hierarchy, intermediate goals are decisions made in the belief that they will serve as the means of achieving one or more ultimate goals. Since a decision among means is relevant to some goal, we have an objective basis (Are the alternative means selected conducive to the achievement of the selected goals?) in this type of decision for determining whether or not a choice among means is a sound decision. In this connection, one very important function that an organization performs is to provide individuals with goals. With ends, goals or objectives largely specified for him, the decisions of a manager are, for the most part, decisions among means.

6. H. G. Emery, K. G. Brewster and Charles H. Fitch, eds. *The New Century Dictionary* (New York: D. Appleton-Century Co., 1944), I, 883.

genuine an intellectual phenomenon as a correct one; the difference lies in its validity.[7].

For the purposes of this study, "judgment" may be taken to mean a definitively assertive intellectual act, that is, an act of the mind by which man positively affirms or denies something of something else.

Decision-making: At this point, it seems valid to conclude that since a decision is a judgment among ends or among means to achieve some end, and since a judgment is an intellectual act, decision-making is, therefore, an intellectual activity.

Method of Approach

"Decision-making" often appears in the guise of Operations Research, defined as "a scientific application to the selection of alternatives under management control."[8] The results of following any given policy can be studied by operations researchers building their hypotheses or models with their tools of statistical and mathematical theories, linear programming, quadratic equations, the theory of games, symbolic logic, probability, search theory, etc. Operations Research men feel that they can now go beyond the mere gathering and patterning of facts to the point where they can recommend or strongly imply a course of action. But they insist that the final decision on broad policy can rest only with management.

Philosophers, too, have their concepts of decision-making, for their purpose is the scientific examination of all realities in their ultimate causality through reason alone. Because the objective of philosophy is the investigation of first causes[9] and since the decision-maker should be guided by right goals, the philosopher is vitally concerned with what the ends or goals of decision-making should be. Moreover, since a decision may also be a judgment among means to achieve some end, the philosopher is greatly concerned with the morality of the means chosen to achieve morally good ends. The philosopher distinguishes between acts of what he calls the speculative intellect and the practical intellect; since decision-making is an act to accomplish some goal, it falls within the functions of the practical intellect.

Not to be ignored by the student of decision-making is the influence of a man's culture, ". . . the instrument whereby the individual adjusts to his total setting [environment] and gains the means for creative

7. Francis Lelande Harmon. *Principles of Psychology.* Rev. ed. (Milwaukee: The Bruce Publishing Co., 1951), pp. 358-9.

8. "What's Ahead for Operations Research?" *Business Week* (August 27, 1955), p. 65.

9. " 'First causes' are *ultimate* in the sense of being the last to be attained but the *first* to be known and desired." Charles C. Miltner. *The Elements of Ethics.* 2nd rev. ed. (New York: The Macmillan Co., 1936), p. 21.

[self] expression."[10] Anthropologists tell us that man differs from the animals because he must rely on an artificially fashioned environment — material, spiritual and social — which becomes a gigantic conditioning apparatus, producing in each succeeding generation its own type of individual. An interesting case in point is described by Fred N. Kerlinger:

> Japanese decision-making derives its pattern from the ethical code which emphasizes the group and de-emphasizes or even decries the individual. A Japanese may go to fantastic lengths to avoid making a decision. . . . In Japan it is considered brash for an individual to make a definite, clear-cut decision regarding himself or others. It is considered offensive for an individual to state his opinion and strongly urge its acceptance — he must use circumlocution and be careful not to offend others or to bring shame or ridicule on himself.[11]

When a manager makes a decision that affects the behavior of others, he sets in motion social processes which have great significance to the social psychologist in terms of the problem of human motives; the psychological and sociological analyses of the properties and products of human group interaction; the psychology of social change; and individual variations in reactions in various social situations. The manager cannot escape the fact that his decisions are made in a social framework.

Yet, a managerial decision still remains a derivative of premises or propositions (antecedents). To doubt this is equivalent to affirming that all decisions of administrators or managers are the arbitrary products of impulse or caprice. A correct and compelling decision is not a simple, unsupported assertion; it is a conclusion which is sustained by the premises or propositions from which it is derived. Because logic guides the intellect with reference to consistency, validity and order in the process of deriving a decision from one or more premises or propositions, it is necessary to consult also the logician in any inclusive study of decision-making.

As a student of human behavior, the experimental psychologist is vitally concerned with the intellectual activity of decision-making. Modern experimental psychology has contributed materially to our knowledge of the conditions which influence the thought processes in action. Because the experimental psychologist has uncovered many facts about intellectual activity that are pertinent to the study of decision-making, his contributions must also be considered.

The specialists cited here are not alone in contributing much valuable research and discussion to the formulation of a complete theory of decision-making. To them might well be added the theolo-

10. Melville J. Herschovitz. *Man and His Works, The Science of Cultural Anthropology* (New York: Alfred A. Knopf, 1948), pp. 640-1.

11. Fred N. Kerlinger. "Decision-Making in Japan," *Social Forces* (October, 1951), XXX, No. 1, 37-8.

gian, the physiologist, the medical man. This discussion can only indicate the extraordinary breadth of the problem and emphasize the need for a comprehensive synthesis of all the relevant contributions from the many fields of human endeavor if decision-making is to be adequately understood by managers.

A DECADE OF WISCONSIN BANKING

by

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The annual reports of the Federal Deposit Insurance Corporation afford those of us concerned with banking some very interesting data for analysis and comparison. The figures presented cover all insured banks, thus giving a broader coverage than any other statistical source on both a national and a state level. Rather detailed presentations of assets and liabilities, earnings and expenses are made available. For the first part of this discussion I wish to present some summary comparisons of what has happened to banking in the United States and in Wisconsin since the end of 1946 covering a ten-year span of prosperity, revival and growth in the most important segment of the national financial community. Following this, I shall make some more detailed comparisons in an attempt to appraise the quality of Wisconsin banking over the past decade. Based on these trends, I shall then make some rather short observations of future developments in Wisconsin banking within the framework of an expanding national economy.

I

In 1946 there were 13,354 banks in the United States; in 1956 there were 13,194, a decline of about one per cent. Unit banks declined 8 per cent reflecting an important movement toward consolidation of banking facilities. In Wisconsin the number of banks remained constant at 545 with virtually no change in the number of unit banks.

We can next turn to the character of the banks as reflected in their assets. Nationally, total assets rose some 36 per cent and in Wisconsin 34 per cent. Cash and balances rose proportionately remaining at about 20 per cent of total assets on both the national and state level. Holdings of U. S. government securities were out almost 50 per cent both nationally and in Wisconsin; but Wisconsin banks, on the whole, carry about 20 per cent more governments than does the average bank in the United States. Other security holdings, chiefly municipals, more than doubled from 1946 to 1956 and now constitute about 8 per cent of total assets. Loans and discounts rose sharply on both the national and state level and now approximate 40 per cent of total assets. On balance, therefore, we can conclude that Wisconsin banks followed the national pattern substituting loans for governments during the past decade. However, governments are still more important to the bank in this state than to the average bank in the United States.

Next let us turn to the use of these assets and the earnings position

of banks. We all know that tightened credit has made for higher rates of return on all categories of assets. Total earnings from operation rose 151 per cent nationally from 1946 to 1956 but only 135 per cent in Wisconsin. In spite of lower holdings of governments, earnings from this part of the portfolio rose 10 per cent nationally and 18 per cent in Wisconsin. The reverse was true for the return on other securities. Wisconsin gained 88 per cent against 107 per cent nationally. On loans and discounts, the national gross rose 352 per cent while Wisconsin's rose 368 per cent.

Some interesting comparisons of rates of return can be made. For example, the return on governments rose from 1.52 to 2.32 per cent in Wisconsin, or 80 points, compared with 82 points nationally. But on municipals the rate fell 6 points nationally to 2.29 per cent, while Wisconsin's return dropped 17 points to 2.15 per cent. The average rate received on loans affords a most interesting comparison. The national rate received in 1946 was 3.38 per cent, some 48 points below Wisconsin's 3.86 per cent; but in 1956 the national average of 5.00 per cent was 12 points over Wisconsin's 4.88 per cent. This might lead one to suspect that the Wisconsin bankers either are not charging enough on loans or have a loan mix concentrated in the lower yield, or wholesale, categories.

Now let us turn to expenses and other outlays. We saw that operating earnings rose 152 per cent nationally. For the nation, operating expenses and taxes rose equally — 152 per cent. While income rose 135 per cent in Wisconsin, expenses advanced only 128 per cent and taxes a mere 78 per cent. This would indicate that Wisconsin bankers were better able to control expenses or cover up on taxable income; the latter appears to me less likely, at least in comparison with other bankers in other states, as we shall see. Yet, we should investigate the expense items to see just where the economy was affected to judge its importance. Salaries, wages and fees to directors and committees in Wisconsin rose about proportionately to the national average of about 150 per cent. But interest on time deposits in Wisconsin in 1956 was only 98 per cent larger than 1946 compared with a national average of 200 per cent. The recent increases in interest rates on time deposits authorized by the state banking authorities will increase expenses, it is true, but even at this overly late date this should help Wisconsin bankers to meet their competition for savings. Whether we have gone too far can only be learned from experience. Dividends to bank shareholders doubled during the decade lagging behind the rewards to all others who furnished assets both on a national and state level. However, the sum total of all these outlays has meant additions of constant amounts to total capital funds rather than increases at a constant rate, exclusive of allowable reserves. Nationally, banks have added about $12 billion a year in almost unvarying amounts; in Wisconsin there has been more fluctuation but a general average of about $600 million a year would be close.

One final comparison is that of the size of the labor force. Nationally, the number of officers rose 41 per cent to over 88,000 and

employees 58 per cent to almost 432,000. Banking thus employs over one half million people, with close to 40 in the average bank. In Wisconsin, there was an increase in the number of officers (26 per cent) to 2,371 and an employee increase (66 per cent) to 7,850. The total of over 10,000 bankers in Wisconsin averages to 22 per bank. We do note, however, that the rate of rise in officers was less and in employees greater than on the national scene.

From these comparisons of change over the decade, 1946 to 1956, we conclude that Wisconsin followed the national pattern in most details. Noticeable deviations exist only in the holdings of government bonds, the rates of return on loans and on municipal securities, the rates paid on time deposits, and the proportionate change in the ratio of employees to officers. We find no substantial evidence of banking being better or worse in Wisconsin than the national average, at least from this analysis.

II

At this point the careful analyst will voice the opinion many of you have been thinking. How can you compare Wisconsin and its unit banking system with the great banks of larger states, some with great branch organizations? What of varying conditions in different sections of the nation? Don't national figures, like a veritable Mother Hubbard apron, conceal more than they disclose?

To meet this criticism, I have studied identical figures from seven midwestern states: Wisconsin, Illinois, Indiana, Iowa, Michigan, Minnesota and Missouri. Illinois, Michigan and Missouri are dominated by metropolitan banks; Michigan has a sizable branch bank operation. If we list the states in order and locate Wisconsin's place in the array, we may make some tentative conclusions about the manner in which Wisconsin banking appears when compared with rather similar situations. Of particular significance are any sizable shifts in relative position in these lists. In these comparisons it is important to note that I am changing a few yardsticks to give more meaningful relationships.

Let us first examine the character of banks in the seven states. Measured on average assets per bank and on growth in assets over the decade, Wisconsin has continued in fifth place leading only Iowa and Minnesota.

Second, what of earnings and rates earned on types of assets? Wisconsin ranks fifth in gross earnings on total assets leading only Illinois and Missouri. In the handling of government securities portfolios, Wisconsin tied with Indiana for fourth place, again leading Illinois and Missouri. The great concentration of correspondent banks and of large corporate balances in Chicago and St. Louis evidently affects the portfolio pattern of these metropolitan centers and thus the state totals.

Wisconsin bankers have lost considerable ground in handling municipals and other securities, falling from first place in 1946 to

third in 1951 and fourth in 1956. Perhaps this is due to a shortening of maturities or perhaps due to unnecessary upgrading of quality. It might be said that these operations reduced the losses which other state banks now face, but they did not contribute to earnings either. In the most important earnings category, loans and discounts, Wisconsin bankers have fallen from fourth in 1946 to fifth in 1951 and to sixth place in 1956; their 4.88 per cent return exceeded only the 4.47 per cent earned on loans and discounts by the Illinois banks. All other states earned over 5 per cent, with Indiana and Michigan ringing up a sizable 5.51 per cent. This record appears to indicate that Wisconsin banks have either been charitable to borrowers, or have gone into wholesale loans rather than retail, or have not taken full advantage of opportunities to increase rates. They might well take a lesson from their Minnesota brothers who raised a 3.70 per cent return in 1946 to 5.22 per cent by 1956.

Turning to operating expenses, we find that total payments for services in the form of salaries, wages and fees give Wisconsin fourth place, or about average, with its 48 per cent of total expenses. It seems that 50 per cent is about tops for any state other than on an occasional basis. In interest rates on time deposits, Wisconsin rose from 0.83 per cent in 1946 to 1.29 per cent in 1956, but fell from fourth to sixth place in the array.

Then what about earnings? Wisconsin is last in rate of net profits retained out of operating income and in the rate of operating earnings on total capital, excluding or including borrowings. Since the state's position in operating expenses is about average, we must conclude that the low earnings rates, or lack of operating efficiency, are to blame for these pessimistic comparisons of rates earned on invested capital.

To test out the validity of these statements I worked out the data on a per officer and a per employee basis. Although trends in number of officers and employees per bank as well as of employees per officer sloped upward, Wisconsin remained in fifth place, about average. So it does not appear that the number of workers is at fault.

Let us consider some measurements on a per officer basis. The trend of gross assets, demand deposits, total deposits and gross operating earnings per officer is upward, with Wisconsin holding fifth place in all these and leading only Iowa and Minnesota. Salaries and fees per officer have likewise risen, but Wisconsin here takes third place over Indiana, Iowa, Minnesota and Missouri. It would seem that the $8,000 paid in salary and fees to the average Wisconsin bank officer is more than ample for the relatively inferior earnings he achieves for the bank.

Now for employees. The trend of total assets and deposits, both total and demand, per employee rose with wages. In total assets per employee Wisconsin dropped from second to fourth place; it did the same for total deposits per employee. In demand deposits per employee Wisconsin remained a very respectable fifth. It would seem that there is some evidence of less productivity per employee based on these measures. Now for gross operating earnings per employee.

Wisconsin fell from first in 1946 to third in 1951 and to fifth place in 1956. And in wages paid, Wisconsin fell from third in 1946 to sixth place in 1956, the average $2,700 a year paid exceeding only the $2,600 registered in Iowa.

What do I conclude from these comparisons? I think Wisconsin bankers have a long way to go to increase efficiency on both the officer and employee level. Perhaps higher wages for employees would permit fewer workers, but of better calibre. Higher salaries and fees for officers will not necessarily do the same trick. It cannot be a case of inability to afford the higher wages or salaries; it must be one of paying more to get more. We must look for better trained bankers — bankers who are more attuned to changing conditions, who are not afraid to take risks, who must "look sharp, feel sharp, be sharp" and "be modern." They must meet competition from non-banking institutions; they cannot remain safety deposit boxes.

III

In the face of this analysis and the forthcoming years, we can now hazard a few predictions. To maintain a stable economy, the banker must continually advocate savings, actively pursue savings, cultivate time deposits. At the same time he must promote wise, but not promiscuous, use of credit. If my ideas of business trends over the next decade are correct, bankers must remember how to handle and manipulate a bond portfolio for the next three or four years; then they must recall their lending principles. This is no time to throw away the bank investment handbook, just because you are all loaned up. Only by intelligent use of bank assets can Wisconsin bankers resume their normal place of about third or fourth position in the arrays I have cited. Only in this way can industry be attracted to Wisconsin and prevent it from decaying.

Meanwhile, wages will increase and salaries will increase. Greater productivity, more assets per employee and officer can develop through mechanization. What of the squeeze between rate ceilings and expenses? Fixed costs of operation can be solved, in my opinion, by some type of consolidation — either by cooperative unit banking or by branch banking; it cannot be done by unit banks acting individually. Correctly and skillfully administered, either system has the ability to solve many of our present and future banking problems. Inefficiently run, both can cause irreparable damage to the state, its business and its population. After all, it is people who make banking, real people whose intelligence, community spirit and sense of morality make banking a cornerstone of our society. Bankers are not a group of money leeches, so they must not act that way toward the public or each other. Through an organization such as this, devoted to the intellectual improvement of its membership and a common sense, common approach to banking problems, much of the groundwork for improvement in Wisconsin banking can be laid.

TABLE 1. Trends in Banking, National and Wisconsin, 1946-1956.

	National	Wisconsin
Number of banks:		
Total	Down 1%	No Change
Unit Banks	Down 8%	Down 0.5%
Character of Banks:		
Total Assets	Up 36%	Up 34%
Cash and Balances	Up 37%	Up 28%
U. S. Securities	Down 27%	Down 23%
Other Securities	Up 114%	Up 102%
Loans and Discounts	Up 210%	Up 248%
Other Assets	Up 122%	Up 82%
Changes in Earnings:		
On Total Assets	Up 151%	Up 135%
U. S. Securities	Up 10%	Up 18%
Other Securities	Up 107%	Up 88%
Loans and Discounts	Up 352%	Up 368%
Changes in Expenses:		
Total	Up 152%	Up 128%
Salaries to Officers	Up 131%	Up 137%
Wages to Employees	Up 160%	Up 154%
Fees to Directors, etc.	Up 146%	Up 166%
Interest on Time Deposits	Up 200%	Up 98%
Net Current Operating Earnings	Up 152%	Up 145%
Income Taxes	Up 152%	Up 78%
Dividends	Up 105%	Up 100%
Net to Capital Funds	$600 million	
(Annual Rate)		$12 million
Personnel:		
Officers	Up 41%	Up 26%
Employees	Up 58%	Up 66%

TABLE 2. Trends in Banking, National and Wisconsin, 1946-1956.

	National		Wisconsin	
Composition of Assets:	1946	1956	1946	1956
Cash and Balances	22%	22%	20%	19%
U. S. Securities	54%	28%	61%	35%
Other Securities	5%	8%	5%	8%
Loans and Discounts	18%	41%	13%	37%
Other Assets	1%	1%	1%	1%
Earnings on Assets:				
Total Assets	1.89%	3.45%	1.82%	3.18%
U. S. Securities	1.48%	2.30%	1.52%	2.32%
Other Securities	2.35%	2.29%	2.32%	2.15%
Loans and Discounts	3.38%	5.00%	3.86%	4.88%

TABLE 3. Wisconsin's Rank Among Seven Mid-Western States* for Selected Bank Ratios — 1946, 1951, 1956.

	Wisconsin's Rank		
	1946	1951	1956
Character of Banks:			
Average Assets per Bank	4	5	5
Growth in Deposits from 1946	–	5	5
Officers and Employees per Bank	5	5	5
Officers per Bank	5	6	5
Employees per Bank	5	5	5
Employees per Officer	4	5	5
Bank Earnings and Expenses:			
Gross Earned on Total Assets	5	5	5
U. S. Securities	4	2	4
Other Securities	1	3	4
Loans and Discounts	4	5	6
Interest Paid on Time Deposits	4	6	6
Salaries and Wages as per cent of Operating Expenses	5	4	4
Bank Profits:			
Net Profit Margin, Before Taxes	6	7	7
Net Operating Earnings on Total Capital Funds	7	7	7
Net Operating Earnings on Capital and Borrowings	7	7	7
Per Officer Comparisons:			
Gross Assets	5	5	5
Total Deposits	5	5	5
Demand Deposits	5	5	5
Gross Operating Earnings	5	5	5
Salaries and Fees Paid	3	3	3
Per Employee Comparisons:			
Total Assets	2	2	4
Total Deposits	2	2	4
Demand Deposits	6	5	5
Gross Operating Earnings	1	3	5
Wages Paid	3	4	6

*States: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri and Wisconsin.

INDUSTRY AND EDUCATION

by

Charles G. Arps

Public Relations Division

Allis-Chalmers Manufacturing Company

Much of the greatness of America is the result of education. All through our history men and women of this country have recognized its many advantages and so have founded and supported schools for our children throughout the land.

The great works of man, whether they are of massive steel and concrete, or of high thought and service, were promoted and nurtured in learning. Learning helps build the positive road to better living and a better, freer America. We should all be thankful that we live in a country that recognizes the value of education and the free exchange of ideas.

Having grown up in America, high school seniors are naturally interested in their future as one important portion of their educational experience is drawing to a close. It's the time to plan for continued training. There are many possible choices to be considered. Some will find it advantageous to train as apprentices in certain crafts, others may go into training in business and still another group will continue a more formal education pattern at the college level.

In any case, a careful assessment of his skills, aptitudes and interests should make it possible for a serious-minded student to make the choice which will be most congenial to him and provide the greatest opportunity for the full development of his maturing personality. Whatever his final decision may be, it is hoped that each will enter his new field of activity with a determination to realize through it a happy and useful membership in our free society.

Allis-Chalmers fully recognizes the financial requirements for those who choose a college career.

In order to encourage talented young people to continue their education, the Company developed a program of scholarships to be given each year to those applicants judged to be the most worthy.

Scholarships of $500 a year are available for sons and daughters of eligible Allis-Chalmers employees. Since this program was inaugurated eight years ago, Allis-Chalmers has awarded 82 of these scholarships.

Twelve awards for the first year of college are given each year, making a total of 48 scholarships over the four years. All of these grants are for one year only, but subject to renewal, provided the scholarship winner satisfies the standards set by the Scholarship Committee.

The award money may be used for tuition, textbooks, living expenses, laboratory fees, or to meet other expenses of similar nature.

Scholarship winners each year are selected by a committee composed of four impartial persons having no official connection with the Company.

Members of this committee consider the following factors in deciding the relative merit of applicants: excellence of moral character, scholastic record, financial need, qualities of leadership, seriousness of purpose, qualities of citizenship, general aptitude for college work as indicated by the College Board Scholastic Aptitude Test Scores and ability to meet specific entrance requirements of the accredited college or university selected by applicant.

Scholarships may be renewed yearly for the four years of college under the same rules of eligibility as for the original award. The Scholarship Committee reviews all renewal applications each year and renewals are subject to the standards required by the Committee. Receipt of a scholarship from another source does not disqualify an applicant from receiving an Allis-Chalmers scholarship the same year.

If a scholarship winner joins a branch of the Armed Forces, his scholarship award is held open until he returns. He then has an opportunity to apply again for the award if he fulfills the eligibility requirements.

Scholarship winners may attend the college or university of their choice and study any course, provided the school is accredited and the course is one which leads to a Bachelor's degree. Each private educational institution attended by students who are awarded new or renewal scholarships also receives $500 each year from Allis-Chalmers and the college or university is free to use this grant in any manner it deems fit.

The recipient has no obligation in any manner to the donor of the scholarship after graduation.

In addition to scholarships to sons and daughters of employees, the Company provides eight $400 scholarships each year as awards to the 4-H club members who raise the best gardens in the National 4-H Garden Award Program. Last year one of the winners had a garden covering 22,000 square feet, entered 30 vegetables in the national contest and won 29 awards, 15 of them blue ribbon winners.

The Company's Educational Assistance Program provides another way of helping an individual carry out his program of self-development. One part of this program is the College Tuition Refund Plan. Its purpose is to encourage and to assist in the self-development of employees through advanced educational study applicable to company operations in engineering, science and business administration. The plan applies to regular employees while actively employed full-time who take approved courses outside of normal working hours at accredited colleges and universities. Participants may attend the accredited college or university of their choice.

The plan also applies to courses taken for credit in engineering, science or business administration at the college level or graduate level. Non-credit courses or courses taken for non-credit purposes are outside the scope of this plan. Courses taken to meet curriculum requirements for a degree in engineering, science or business administration are within the scope of this plan even though the individual course might be outside these fields, as in the case of a non-technical course. An apprentice machinist has completed six courses in mechanical engineering . . . and, a few months ago, six participants in the program received their master's degrees.

"Twilight courses" in clerical studies, scheduled immediately after working hours, have been arranged with schools in plant cities. The Company pays the tuition, the employee pays the cost of the texts and materials.

The complexity of our present age often requires education more advanced than a bachelor's degree. One of the firm's able young electrical engineers felt he needed more education before tackling advanced problems in power systems engineering. With the help of an Allis-Chalmers fellowship, he spent a year in residence study at a university to gain the desired background.

In cooperation with the University of Cincinnati, a doctor completed his residency in occupational medicine at the Company's West Allis Works. He is now chief of clinical services in the medical section.

Another Allis-Chalmers program makes it possible for educators to bring students into our plants to observe engineering in action and see practical applications of business administration and science in industry. During 1956, more than 14,000 students visited the West Allis Works alone and similar visits were conducted at practically all company plants in the United States and Canada. Educators themselves often request permission to come into company plants. For instance, early this spring a group of principals and teachers from grade, high and vocational schools made a specially arranged tour of the West Allis Works. These educators were able to make on-the-spot evaluations of opportunities for their students. They asked many questions of the executives after the tour — and discussed the answers in detail to gain a better understanding of industry.

For many years, Allis-Chalmers has cooperated with college educators to help them keep up-to-date on progress in industry. Since 1952, we have had two college professors for a six weeks course in study of our company's operations. On the program this year were college professors from Marquette University in Milwaukee and Nebraska State Teachers College at Kearney, Nebraska. The program is carried out in cooperation with the Foundation for Economic Education. This kind of knowledge helps college professors guide and counsel their students to a better understanding of the variety of employment opportunities open in industry.

The Allis-Chalmers Foundation is also active in educational circles. In addition to the $500 award made by the Foundation to private

colleges and universities attended by an Allis-Chalmers scholarship winner, the Foundation makes other contributions to education. In practically all of the States, the independent colleges have organized into one group — with a united assistance fund. The Foundation contributes to these state independent college organizations where the company has manufacturing operations.

The most recent addition in the field of Allis-Chalmers' assistance to education is the expanding Summer Science Fellowship Program. Begun in 1956 with three Milwaukee County high school science teachers, the program this year included nine science teachers from Milwaukee, Wisconsin; Pittsburgh, Pennsylvania; and Springfield, Illinois.

These twelve high school science teachers now possess up-to-date, on-the-job knowledge of what a scientist or engineer does for a company such as Allis-Chalmers. With this knowledge, they are better able to spot the potential engineers and scientists in their classes and help those students prepare for a technical career.

Can industry assist education? Can education assist industry? Yes! Educators and industrialists both welcome this cooperation. It makes us all the more aware that the future of our society depends a great deal upon untried ideas — fresh enthusiasm — a public spirit — open minds — and, above all, a continuing supply of new knowledge.

EVENING DIVISION EDUCATION - 1957

by

Brother Leo V. Ryan, C.S.V.

Director, Evening Division

Robert A. Johnston College of Business Administration

The Robert A. Johnston College of Business Administration of Marquette University has been organized with the aim of developing students who will be intellectually and professionally equipped to understand and to solve complex business problems. The student develops the foundations for personal growth and for leadership in the business and civic life of the community. The general concept of "educating the whole man" forms the basis for the undergraduate and graduate curricula. Specific areas of concentration are presented in Evening Division courses, semester-length Institutes and in two- and three-day management conferences. These educational programs are developed in cooperation with local technical and professional associations.

Evening Division students must meet the same requirements demanded of the day school student body for acceptance in undergraduate and graduate degree programs. The constant upgrading of standards both for student and faculty performance has given Marquette University a position of distinction in the American Association of Collegiate Schools of Business and should assure business and industry that Marquette graduates not only represent a select segment of the current college population but also possess leadership potential in their many areas of major study.

These students represent an important cross section of the business community. Full-time employees in a wide variety of enterprises, they come to the classroom to supplement the many skills and abilities which they have been exploiting on a purely practical plane during their eight hours on the job. On the whole, these students are more mature individuals, receptive to the concentrated effort required of them because they know from their daily work experience the value to be derived from additional education. Many of them enroll in the Evening Division upon recommendation of their employers or on company sponsored tuition or tuition refund programs. The value of this special training is apparent. The classroom presentation of business theory provides a framework around which the practice of business may be developed and explained. The contact with criteria, norms, principles and standards, the stimulation and challenge of new and fresh ideas presented in classroom lectures and discussions serve to broaden and deepen the student's grasp of his subject matter and to widen the horizon of his thinking. The challenge to the imagination, the invitation to consider the totality of the business environment, the introduction of a macro rather than a micro approach to the economic structure, all have rewards for both the individual and his business associates.

Most employees enter the business community with specific qualifications. The need for their services is great and immediate. But as an individual progresses through the ranks of business to supervisory, intermediate, middle and top management positions, the need becomes even greater for an increased integration of knowledge, for an ability to communicate more effectively, to understand human motivations and to inspire leadership. The more limited knowledge of the specialist must be integrated with the broad objectives and needs of management. In this area, the University has a definite contribution to make. The function of instruction in a College of Business Administration is designed to achieve balance between the liberal arts, skills and specialized courses. The Evening Division makes available a complete course leading to the Bachelor's Degree in Business Administration, with majors in accounting, economics, finance, general business, marketing, production and personnel administration. In addition, most graduate training in business is offered in evening classes. Graduate preparation in business has been encouraged by officers and personnel managers in many Milwaukee firms. Engineers, liberal arts and business administration graduates and some professional school graduates are now enrolled in the Master in Business Administration program for the purpose of seeking an understanding of the characteristics, institutions and processes of the free enterprise system. Having examined the nature of business and the methods and techniques by which management accomplishes its objectives, the specialist leaves the classroom and returns to work better equipped and prepared for advancement through the various levels of management to new positions of leadership.

Many Evening Division students have already completed their formal education or do not have the time to devote to a complete undergraduate or graduate curriculum; yet they feel a definite need for additional education to supplement their present knowledge or to prepare themselves for better service to their companies. A variety of semester-length Institutes is designed to impart theory and training in specific areas of business. These are open to any member of the business community who has experience and interest in the subject matter or who can benefit by participation in such an Institute. These Institutes are frequently originated by business and trade groups as well as by the University staff. They may be co-sponsored by trade associations. Among the Institutes established for persons who already have a basic or even extended knowledge in the field, the Certified Public Accountant's Review has been offered annually for some years to prepare accountants for the CPA examinations. Systems for Management was established in cooperation with the Milwaukee Chapter of the Systems and Procedures Association; a series of five Institutes on Insurance has been developed for insurance agents, brokers and salesmen; Business Theory for Secretaries prepares for the Certified Professional Secretary examinations. In the fall of 1957 a special Institute in Real Estate Law was initiated to prepare individuals to qualify for the Wisconsin broker and salesman licenses. Currently in preparation are new Institutes for restaurant management and for service station management developed respectively with

the Wisconsin Restaurant Association and the local petroleum companies.

Special courses carrying University credit, originally designed to serve the specific needs of Milwaukee industries, have developed into regular curriculum offerings. These are exemplified by Management, Planning and Control Through Budgeting and Industrial Purchasing. A recent addition to this group is Industrial Selling, planned for February, 1958, which will be given for employees selected by the Control Sales Section of the Hawley Works, Allis-Chalmers Manufacturing Company. Engineers who are strong on product knowledge will study industrial marketing, the selling process and the selection of sales techniques appropriate to their market. This approach represents an effort to provide a theoretical framework and a practical basis for broadening the knowledge of technical specialists in one aspect of business.

The College of Business Administration further serves the business community through the activities of the Management Center and the Bureau of Business and Economic Research. These activities extend far beyond the confines of the classroom or of the local community. The objective of the Management Center is the preparation of professional managers and supervisors for business and industry. This objective is implemented through educational programs directed toward all levels of participation from general fundamentals for beginning students to workshops, forums and conferences for top and middle management.

The function of the Bureau of Business and Economic Research is to extend the University to the business community, the civic community and individuals by making available reports of studies on business and economic subjects containing information of value in making management decisions; to serve the community by carrying on studies of community or general interest; and to assist graduate students in carrying out and publishing worth-while research projects.

These, then, are the opportunities which Marquette University offers for fundamental and advanced training in business. A university does not exist alone for the courses which it makes available, but rather for the individuals who avail themselves of those courses. University Evening Divisions have opened their doors to a new and different student population — usually older, more mature, in large part seasoned by war and the exacting demands of supporting a family. These students are not inexperienced — they have spent a working day at a desk or on an assembly line; they have struggled over accounts and unsnarled production problems. These are the students who are demanding more and better training on higher levels and in wider areas. These are the students who bring with them a rich background of experience which is invaluable as a foundation for the advanced training which they seek. They are deeply aware of the need for more knowledge and it is through the satisfaction of that need and through the acquisition of that knowledge that each student comes to be a better individual and a better member of the business community.

LINEAR PROGRAMMING AS A TOOL OF THE BUSINESS EXECUTIVE

by

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One of the most interesting developments in recent years is the mathematization of the science of management. Scientific discoveries, technical progress and rapid mechanizations require the differentiation and segmentation of the management function. Where some statistical data, simple figures and their elementary interpretation were formerly sufficient, more advanced methods are now a necessity.

The decision-making of a modern executive is a result of his own research and the recommendations of a team of specialists. The industrial and quality control engineer now has a permanent and important role in industry, the statistician-economist in consumer surveys and sales analysis. The operational analyst is the executive's newest advisor. His area of activity is Operational Research, which from humble beginnings in the military field is fast spreading into industry and business. All these specialists have some common tools: the theory of probability and statistics, the theory of games and stochastic processes, the theory of the waiting line, the Monte Carlo method and mathematical programming.

Linear programming is a relatively new procedure, a particular aspect of mathematical programming which makes possible the solution of a wide variety of industrial and business problems. There are several methods, all basically simple, adjusted to special problems.

The general method of solving a large number of linear programming problems is known as the SIMPLEX METHOD, which has been developed by Dantzig.[1] It provides a systematic way of improving the allocation of resources step by step until the final unique solution, if it exists, is reached. When the optimum solution has been obtained, no further improvement under constant conditions is possible. The procedure, once the problem is formulated and the simplex matrix constructed, is elementary arithmetic similar to the solution of the system of linear equations by systematical elimination of unknown variables in the augmented matrix.

The theory, notation and symbolism in mathematical literature is complicated and hardly comprehensible to the non-mathematician. In this paper, we have chosen a typical, simple miniature problem to demonstrate the simplicity and effectiveness of this simplex method. It is only one particular case of finding a maximum profit. It may be formulated this way:

1. G. B. Dantzig. "Computational Algorithm for the Simplex Method," *Notes on Linear Programming*, Part III (Santa Monica, Calif.: Rand Corp., 1953), p. 394.

A manager of a food processing company is studying the possibilities of improving the profits made on three similar products, each one the result of a two-stage process. At the beginning of the study, in the time unit interval, they produce:

5,000 cans of product P_1 with a profit of 50 cents per can,
10,000 cans of product P_2 with a profit of 30 cents per can,
20,000 cans of product P_3 with a profit of 25 cents per can.

They are working to capacity on the first-stage process, but not to capacity on the second stage. This is the question: Since the source of the material and the sale of it are practically unlimited, is it possible to change the production in such a way that the profit will be larger?

The limitations and constraints of production are given here by the production hours available. The average time expenses in the production of every can have been found, stated and necessary notations introduced:

Let the number of cans produced be x_1;

x_1 of Product P_1,
x_2 of Product P_2 and
x_3 of Product P_3.

In the first stage, 50 cans of the product P_1, 33 cans of P_2 and 100 cans of P_3 are produced in one hour. Respectively, 33, 50 and 100 cans of products P_1, P_2 and P_3 are produced in the second stage.

We may write the four inequalities:

$$
\begin{array}{lrcl}
(1) & 0.02\,x_1 + 0.03\,x_2 + 0.01\,x_3 & \leqq & 600 \text{ hours,} \\
(2) & 0.01\,x_3 & \leqq & 500 \text{ hours,} \\
(3) & 0.02\,x_2 & \leqq & 300 \text{ hours,} \\
(4) & 0.03\,x_1 & \leqq & 200 \text{ hours.}
\end{array}
$$

The 600 hours are the limit of the first process, the 500 hours the maximum available time for the second process of P_3, 300 for P_2 and 200 for P_1. The profit equation, which will serve as the indicator in the solution of these inequalities, is

$$(5) \quad Z = 0.50\,x_1 + 0.30\,x_2 + 0.25\,x_3.$$

At the time of the study they produced 5,000 cans of product P_1, which means 150 hours of a possible 200 hours in the second stage; 10,000 cans of product P_2, working 200 hours of 300 hours available and 20,000 cans of product P_3, which has a limit in the second stage of 500 hours. Of course, the main constraint here is the first-stage production. By this schedule, they utilized completely the first-stage 600 hours:

$x_1 = 5{,}000,$
$x_2 = 10{,}000,$
$x_3 = 20{,}000.$

100 hours + 300 hours + 200 hours = 600 hours. The profit was: $Z = 2{,}500 + 3{,}000 + 2{,}500 = 8{,}000$ dollars. Elementary analysis led to this new, better schedule:

$$x_1 = 6{,}500,$$
$$x_2 = 7{,}000,$$
$$x_3 = 26{,}000,$$

which means better use of the second stage than at the full use of 600 hours in the first stage, since the profit was $Z = 11{,}850$ dollars. By process of iteration or relaxation, it would be possible to get a still higher profit.

The Simplex Method is direct and gives a unique solution in four steps, so we will demonstrate this technique.

The five relations (1) to (5), are sufficient to form a simple matrix and to find the corresponding solution. The first step of formulation in the matrix is to multiply the (1), (2), (3) and (4) by 100, to eliminate the unnecessary original fractions, and then to introduce arbitrary artificial variables, say u_1, u_2, u_3 and u_4, which change the inequalities

(1), (2), (3) and (4) into regular equations:

$$(1^1) \quad 2x_1 + 3x_2 + x_3 + u_1 + 0u_2 + 0u_3 + 0u_4 = 60{,}000,$$
$$(2^1) \quad 0x_1 + 0x_2 + x_3 + 0u_1 + u_2 + 0u_3 + 0u_4 = 50{,}000,$$
$$(3^1) \quad 0x_1 + 2x_2 + 0x_3 + 0u_1 + 0u_2 + u_3 + 0u_4 = 30{,}000,$$
$$(4^1) \quad 3x_1 + 0x_2 + 0x_3 + 0u_1 + 0u_2 + 0u_3 + 0u_4 = 20{,}000,$$

and by addition of the (5) in the form,

$$(5^1) \quad -0.50x_1 - 0.30x_2 - 0.25x_3 + 0.u_1 + 0.u_2 + 0.u_3 + 0.u_4 + Z = 0.$$

Arbitrary variables are positive and serve as basis-variables in the process of solution. The Z profit variable equation is the last row in the constructed system. The values of coefficients in the profit function are negative and the Z may occur in the matrix as one other variable, as in the simplex matrix, Table I. Since all variables must be positive or zero, $0 \leq x_i$, $0 \leq u_i$ and $0 \leq z$, the solution will be done if all indicators in the last row, now negative, will be zero or positive. The artificial variables in the final solution must be zero.

This way we get the maximum profit program. The column of the variable Z is omitted in the simplex matrix, because it will be unchanged in the process of elimination. Instead of it, a control column, for checking the arithmetic, is added.

The complete solution is a routine arithmetical operation on rows of matrices. In the five Tables, II to VI, all steps of the solutions are given. The theory of construction or formulation of problems has been

2. A. Charnes, W. W. Cooper and A. Henderson. *An Introduction to Linear Programming* (New York: John Wiley and Sons, 1953).

explained by Charnes,[2] the arithmetic has been developed by Dantzig,[3] and the reader may find some examples in Noble,[4] Vajda,[5] and Churchman.[6]

Table I has all the necessary items of the linear system called simplex matrix: original variables x_1, x_2 and x_3 have corresponding coefficients in the first part of the matrix; the artificial variables u_1, u_2, u_3 and u_4 in the second part form a unit matrix. The Z, before the last column, may be omitted because by process of elimination it is unchanged. The last column (R) means "Requirements," the upper limits. The last row, first column, where letter I is the first letter of "Indicator," introduces the coefficients of the profit function. Rows 1, 2, 3 and 4 in the matrix start with the artificial or basis-variables. These artificial variables must have this positive coefficient 1, and occur only once in every equation. They serve as a basis in the process of solution, which will be done here if all indicators are positive or zero. This means optimum solution, maximum profit. The value of profit, directly in dollars, will occur in the last row, last column rectangle.

The trivial case, minimum result, can be read from Table I. If x_1, x_2 and x_3 are all zero, the indicators will be zero, u_1 will equal requirements and the profit is also zero.

The real, optimum solution proceeds as follows:

1) Find the smallest indicator. In our case, in Table II, it is —.50 in column (1) which has non-basis, original variable x_1.

2) Find the smallest ratio between R (requirements) and the numbers in the first column. We have:

$$\frac{60{,}000,}{2} \quad \frac{50{,}000,}{0} \quad \frac{30{,}000}{0} \text{ and the smallest ratio } \frac{20{,}000.}{3}$$

It means that the variable x_1 will replace the variable u_4. The term of the smallest indicator and smallest ratio is called the PIVOT. This term, which must then be unity, serves to transform the matrix in Table II into the matrix in Table III. The new matrix, which will have x_1 instead of u_4, must have all other terms in column (1) zero. This is done by simplex algorithm, or by these simple eliminations:

3) Do the division of the row with the pivot by 3. The result is the fourth row in Table III.

4) To get zero in the first column first row, we may, corresponding to matrix algebra, subtract from the first row in Table II the new row in Table III, multiplied by 2. We get:

3. Dantzig, *op. cit.*

4. C. E. Noble. "Extending the Application of Mathematics in Industry," *A.S.Q.C. National Convention Transactions* (Milwaukee: 10th Annual Convention, 1956).

5. S. Vajda. *The Theory of Games and Linear Programming* (London: Methuen and Co., 1956).

6. C. W. Churchman, R. L. Ackoff and E. L. Arnoff. *Introduction to Operations Research* (New York: John Wiley and Sons, 1957).

2	3	1	1	0	0	0	60,000	60,007
—2	0	0	0	0	0	—⅔	—40,000 / 3	—20,004 / 3
0	3	1	1	0	0	—⅔	180,000 - 40,000 / 3	140,013 / 3

This result is written in Table III in the first row. Rows two and three are obviously unchanged in the new table, because we have in column (1) the zeros.

5) To have zero in the last row, column (1), we may simply find the algebraic sum of row I, Table II, and one-half of row x_1 in Table III:

—.50	—.30	—.25	0	0	0	0	0	—1.05
.50	0	0	0	0	0	1/6	20,000 / 6	20,004 / 6
0	—.30	—.25	0	0	0	1/6	10,000 / 3	3332.95

This result is written in the last row of Table III and the transformation-elimination of one basis-variable is finished.

Now we repeat these two procedures. The smallest indicator is —.30, the smallest positive ratio for pivot in the second column and third row. The x_2 will replace u_3 in the next Table IV.

1) To get 1, we divide the third row by 2 and write a new third row in Table IV.

2) To eliminate 3 in the first row, column (2), and —.30 in the last row, we repeat the process of the previous step and get the complete Table IV.

The elimination of —.25, the transformation of Table IV into Table V, does not finish the process. We still get one negative indicator in column (6). The smallest positive ratio is for the third row, which means that u_3 will come back in the original place, as in Table I. This last transformation gives us finally Table VI, with all indicators zero or positive and with an optimum profit of 15,000 dollars.

The last column in every table, column C.C., is a control of the arithmetic involved. The direct computation and the summation of values of columns (1) to (8) must give the same number. The values of x_1 and x_3 are given directly in the column R:

$$x_3 = \frac{280,000}{6} = 46,666.6 = 46,666.$$

$$x_1 = \frac{20,000}{3} = 6,666.7 = 6,667.$$

The product P_2 is completely eliminated from the production. Under constant conditions, no other program with a higher profit exists.

This small example serves as an exposition of simplex technique and shows linear programming at work. The theory may be difficult, but the application involves only high school algebra and arithmetic. Anybody who knows how to solve an equation of two linear variables may learn to use this method.

Table I.

	Original variables			Artificial variables					
	x_1	x_2	x_3	u_1	u_2	u_3	u_4	Z	R
u_1	2	3	1	1	0	0	0	0	60,000
u_2	0	0	1	0	1	0	0	0	50,000
u_3	0	2	0	0	0	1	0	0	30,000
u_4	3	0	0	0	0	0	1	0	20,000
I	—.50	—.30	—.25	0	0	0	0	1	0

Table II and III.

0	1	2	3	4	5	6	7	8	9
	x_1	x_2	x_3	u_1	u_2	u_3	u_4	R	C.C.
u_1	2	3	1	1	0	0	0	60,000	60,007
u_2	0	0	1	0	1	0	0	50,000	50,002
u_3	0	2	0	0	0	1	0	30,000	30,003
$u_4 \leftarrow$	(3) ↓	0	0	0	0	0	1	20,000	20,004
I	—.50 ↑	—.30	—.25	0	0	0	0	0	—1.05
u_1	0	3	1	1	0	0	$-\frac{2}{3}$	$\frac{140,000}{3}$	$\frac{140,013}{3}$
u_2	0	0	1	0	1	0	0	50,000	50,002
$u_3 \leftarrow$	0	(2) ↓	0	0	0	1	0	30,000	30,003
x_1	1	0	0	0	0	0	$\frac{1}{3}$	$\frac{20,000}{3}$	$\frac{20,004}{3}$
I	0	—.30 ↑	—.25	0	0	0	$\frac{1}{6}$	$\frac{10,000}{3}$	3,332.95

Table IV and V.

0	1	2	3	4	5	6	7	8	9
	x_1	x_2	x_3	u_1	u_2	u_3	u_4	R	C.C.
u_1←	0	0	↓ 1	1	0	$-\frac{3}{2}$	$-\frac{2}{3}$	$\frac{10,000}{6}$	$\frac{9,999}{6}$
u_2	0	0	1	0	1	0	0	50,000	50,002
x_2	0	1	0	0	0	$\frac{1}{2}$	0	15,000	15,001.5
x_1	1	0	0	0	0	0	$\frac{1}{3}$	$\frac{20,000}{3}$	$\frac{20,004}{3}$
I	0	0	—.25 ↑	0	0	$.\frac{3}{2}$	$.\frac{5}{3}$	$\frac{47,000}{6}$	$\frac{47,000.4}{6}$
x_3	0	0	1	1	0	$-\frac{3}{2}$	$-\frac{2}{3}$	$\frac{10,000}{6}$	$\frac{9,999}{6}$
u_2	0	0	0	—1	1	$\frac{3}{2}$	$\frac{2}{3}$	$\frac{290,000}{6}$	$\frac{290,013}{6}$
x_2←	0	1	0	0	0	↓ $\frac{1}{2}$	0	15,000	15,001.5
x_1	1	0	0	0	0	0	$\frac{1}{3}$	$\frac{20,000}{3}$	$\frac{20,004}{3}$
I	0	0	0	.25	0	$-\frac{.45}{2}$ ↑	0	$\frac{49,500}{6}$	$\frac{49,500.15}{6}$

Table VI.

0	1	2	3	4	5	6	7	8	9
	x_1	x_2	x_3	u_1	u_2	u_3	u_4	R	C.C.
x_3	0	3	1	1	0	0	$-\frac{2}{3}$	$\frac{280,000}{6}$	$\frac{280,026}{6}$
u_2	0	—3	0	—1	1	0	$\frac{2}{3}$	$\frac{20,000}{6}$	$\frac{19,986}{6}$
u_3	0	2	0	0	0	1	0	30,000	30,003
x_1	1	0	0	0	0	0	$\frac{1}{3}$	$\frac{20,000}{3}$	$\frac{20,004}{3}$
I	0	.45	0	.25	0	0	0	15,000	15,000.7

WATCH WISCONSIN

A Comparative Analysis of Retail Sales Trends

by
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Total retail sales in October were estimated at $17.1 billion, which was 6 per cent above the year-ago level. With a 3 per cent rise in prices, this means a gain of 3 per cent in physical volume.

It appears now that total sales for the year 1957 will exceed the $200 billion mark for the first time in history. Sales for the first 8 months of 1957 were 6.4 per cent above the corresponding period of 1956.

In view of the growing list of economic sectors beginning to show signs of slackening, which includes manufacturers' new orders, unfilled orders and capital spending, the continued upswing in retail sales appears somewhat surprising.

Although still running below year-ago levels, new residential construction shows some signs of recovery, which could have good repercussions on future gains in sales of furniture and appliances — the one category of retailing that has gained the least over 1956.

Other retailing categories that have fallen behind include department store sales, which are still running behind the 3 per cent price gain. This appears to be a long term phenomenon, possibly reflecting the inroads of suburban shopping centers, discount houses, and the emphasis of such merchandising lines as apparel which have lost out in relative importance in recent years.

In a recent study by R. D. Entenberg of the University of Pittsburgh on "The Changing Competitive Position of Department Stores in the United States," he found that department store sales accounted for 9.0 per cent of total retail sales in 1929, but for only 6.4 per cent in 1957.

Over the past five years significant variations in rates of gain have appeared in the various categories of retailing. Gasoline sales have gained the most (38 per cent), whereas catalog mail order sales have gained the least (5 per cent). Expenditures on apparel have increased only 9 per cent, whereas expenditures on transportation have increased 31 per cent and household expenditures have increased 25 per cent. Total retail sales show a gain of 17 per cent, whereas total consumer expenditures are up 22 per cent reflecting the increased importance of services.

This changing structure in retailing reflects changes in consumer expenditure patterns, which in turn flow from the upgrading of in-

come (particularly among the wage earning group which shows the greatest gain in discretionary spending power) and the continuing suburban shift in which formal clothes lose out while the cost of transportation and housing operations increases.

Sales for the first 8 months of 1957 compared with the first 8 months of 1956 by major retailing categories were as follows:

	Per Cent Change
Total Retail Sales	6.4
Gasoline Service Stations	10.7
Food	8.7
Automotive	8.3
Drug and Proprietary	7.8
Apparel	5.8
General Merchandise	3.1
Eating and Drinking Places	2.8
Lumber, Building and Hardware	1.3
Furniture and Appliances	0.7

Among the states currently showing gains in total retail sales exceeding the national average are: Alabama (8.8 per cent), Arizona (9.2 per cent), Florida (11.6 per cent), New Mexico (14.1 per cent), North Dakota (9.6 per cent), and Utah (8.7 per cent).

Cities currently reporting gains of 10 per cent to 20 per cent above the national average are: Middletown, Connecticut; San Diego, California; Orlando, Florida; San Jose, California; Florence-Sheffield, Alabama; Savannah, Georgia; St. Petersburg, Florida; and Lexington, Kentucky.

Note that for the first time Milwaukee fell below the national average rate of gain; whereas Appleton continues to show relatively marked gains. Superior and Beloit-Janesville continued above the national average and Racine exceeded the national average for the first time in many months.

*Monthly Index of Retail Sales vs. Year Ago

	1957 vs. 1956		
	Oct.	Sept.	Aug.
National Average	106.0	104.0	102.0
MAJOR CITIES			
San Diego	120.9	121.3	120.0
Pittsburgh	109.7	108.2	107.2
New Orleans	108.0	106.3	104.9
Los Angeles	107.3	105.2	102.4
Baltimore	107.2	105.8	103.0
Chicago	106.8	104.0	100.2
Cleveland	106.6	104.3	102.9
Atlanta	106.6	104.6	100.7
Washington, D. C.	106.5	103.4	99.6

Dallas	106.2	102.0	100.6
Detroit	105.9	104.2	101.9
MILWAUKEE	105.8	102.5	102.0
New York City	105.4	105.5	102.8
Minneapolis	105.4	101.0	99.5
Boston	104.6	103.0	99.8
Houston	104.0	102.9	102.5
San Francisco	102.9	101.7	102.4
Philadelphia	102.9	99.9	97.7
St. Louis	102.6	101.0	97.9
Buffalo	101.5	99.5	99.3
Cincinnati	100.6	98.6	96.6
Kansas City	99.1	101.2	99.7
Other Wisconsin and Illinois Cities			
Appleton	111.7	111.0	112.0
Superior	108.1	105.1	104.2
Beloit-Janesville	107.6	104.9	105.3
Racine	106.4	102.4	100.1
Sheboygan	104.7	103.8	103.3
Madison	104.4	99.1	96.8
Green Bay	103.9	102.3	101.8
Oshkosh	100.7	98.6	96.6
La Crosse	100.0	99.1	96.4
Kenosha	99.4	95.4	92.4
Moline-Rock Island	111.6	108.0	106.5
Bloomington	105.4	103.4	101.9
Rockford	105.2	103.0	102.2
Springfield	105.2	103.9	102.0
Champaign-Urbana	105.0	101.8	100.3
Decatur	104.6	100.4	99.3
Peoria	103.4	101.5	98.8

*Source of data: Sales Management.

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ROBERT A. JOHNSTON COLLEGE OF BUSINESS ADMINISTRATION
MARQUETTE UNIVERSITY
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